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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

August 28 - September 3, 1998

Summary 98-35

Operating Experience Weekly Summary 98-35

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EVENTS

1. BOOM FAILURE ON BUCKET TRUCK

On August 19, 1998, at Oak Ridge Environmental Restoration Operations, a fiberglass boom on a bucket truck broke and dropped approximately 3 feet as two linemen performed cable-end preparations about 25 feet above the ground. A steel cable that runs through the hollow boom and attaches to the bucket and the internal metal reinforcements arrested the fall. The linemen lowered the boom/bucket and safely exited the bucket. Both linemen were secured with safety harnesses and lanyards and were not injured. This event could have resulted in serious injuries or fatalities. (ORPS Report ORO--BNFL-K32-1998-0003)

Investigators believe the fiberglass boom, manufactured by Hi-Ranger, was less than a year old and had been inspected and tested about 1 month earlier. They determined that the boom broke approximately 4 feet from the bucket and that the bucket had been stationary for 5 to 10 minutes before the boom broke and fell. They also determined that the rated capacity of the boom/bucket was not exceeded. Investigators determined that the steel cable functions to keep the bucket level as the boom moves vertically (see Figure 1-1). Investigators also determined that the boom broke at the point where it latches to a cradle used to limit its movement when the truck is moving. Facility managers contacted Hi-Ranger, and the manufacturer is investigating the cause of the break. The subcontractor and facility managers are also investigating the failure. OEAF engineers will follow the investigation and provide information as it becomes available.

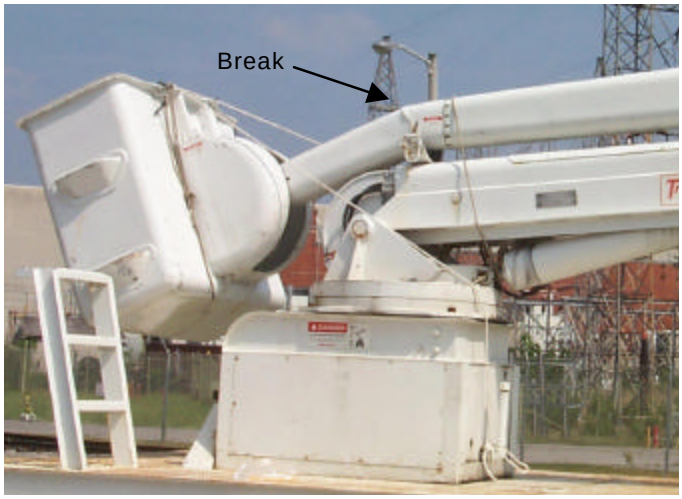

Figure 1-1. Bucket Truck Boom

NFS reported in Weekly Summary 98-22 that a boom fell, struck a maintenance worker, and pinned one of his fingers to a railroad tanker car when a hoisting cable broke. Maintenance workers were transferring sulfuric acid from the tanker car to a facility tank. They used the boom to raise and lower piping and a flange to the top of the tanker car. Investigators determined that the cable, which was not weather-proof, had been exposed to weather elements over a 10-year period, and no one inspected it before the operation began. (ORPS Report ORO--LMES-Y12NUCLEAR-1998-0044).

OEAF engineers searched the ORPS database and recent newspaper articles for related events dealing with booms or bucket trucks. We found the following reports on associated events.

- On August 23, 1998, at a naval base in Maine, failure to use fall protection resulted in a serious injury and a fatality when workers were thrown from an elevated bucket. (Bangor Daily News, 8/24/98)

- On September 25, 1996, at the Hanford site, two subcontractor employees fell from a basket when it tilted from a vertical to horizontal position as they installed a powerline. Both individuals were wearing fall protection in the form of body harnesses and 6-foot lanyards. Because they used fall protection, neither individual was injured. (ORPS Report RL--BHI-GROUNDWTR-1996-0003)

- On September 11, 1991, at the Oak Ridge Y-12 site, as a subcontractor lineman foreman and a co-worker installed light fixtures, the lineman foreman was thrown from an aerial bucket when he tried to free a drill bit that was stuck in a pole. He landed on the bed of the truck and received lacerations and contusions. The lineman foreman was not wearing a safety belt, as required by OSHA standards. (ORPS Report ORO--MKFO-Y12CONSTRM-1991-1009)

These events underscore the importance of following guidelines for the use of personnel lifting equipment. They also underscore the need for adequate fall protection safety equipment when working from an elevated position. Facility managers should review the following guidance and should ensure that it is applied when work is performed from elevated positions.

- DOE-STD-1090-96 (rev-1), *Hoisting and Rigging (formerly Hoisting and Rigging Manual)*, chapter 4, “Lifting Personnel,” covers the selection, inspection, and use of personnel lifting devices.

- 29 CFR 1926, *Safety and Health Regulations for Construction*, sub-part M, "Fall Protection" (1926.500 to 1926.503), governs the use of fall protection when working 10 feet or more above the next lower level.

KEYWORDS: inspection, fall, fall protection, boom

FUNCTIONAL AREAS: Construction, Hoisting and Rigging, Work Planning

2. ELECTRICIAN OBSERVES ELECTRICAL ARC WHILE WORKING ON AN ENERGIZED TRANSFORMER

On August 26, 1998, at the Rocky Flats Environmental Technology Site Plutonium Processing and Handling Facility, a subcontractor electrician observed an electrical arc from a primary-phase winding connection on an energized 480-volt, three-phase transformer to a ground-strap while he was working on it. The arc left burn marks on the electrician’s protective glasses, but he was not injured. Investigators believe that material the electrician was removing from the area accidentally contacted a ground-wire lug, causing the arc. Investigators determined that the electrician planned to continue work after the arc occurred. However, a facility representative that was present informed him that he needed to stop work and notify facility personnel. Facility personnel terminated transformer work after they were notified and applied a lockout/tagout on the system. Investigators determined that the arc damaged the transformer, but have not yet determined to what extent. The electrician was wearing eye protection and rubber gloves in accordance with an energized electrical work permit. Although the electrician was not injured,

there was potential for serious injury and the transformer was damaged. (ORPS Report RFO--KHLL-371OPS-1998-0065)

Workers use energized electrical work permits when it is not feasible to de-energize critical electrical equipment before working on it. Investigators determined that the approval authority for the energized electrical work permit did not identify any critical loads supplied by the transformer and did not walk-down the work before approving the permit. They also determined that the transformer provides power to non-safety-related process equipment. The facility manager directed facility personnel to perform a failure-mode analysis on the transformer and will determine additional corrective actions as necessary.

NFS has reported similar events involving accidents while working near energized equipment. Following are some examples.

- Weekly Summary 98-29 reported that an electrician at the Hanford Site N-Reactor observed an electrical arc and fireball while disconnecting circuit leads from a 480-volt motor control center. The fireball resulted after a bare ground-wire came in contact with the exposed, energized feeder bus in the motor control center. (ORPS Report RL--BHI-NREACTOR-1998-0020)

- Weekly Summary 98-17 reported that riggers at the Hanford Site 221-U Canyon were replacing the wire rope on a 75-ton bridge crane when one end contacted an exposed, energized, 480-volt electrical bus, causing an arc. Investigators determined that the activity hazard analysis did not identify the energized bus as a hazard. (ORPS Report RL--BHI-IFSM-1998-0005)

- Weekly Summary 97-44 reported that two subcontractor electrical workers at Fermi National Accelerator Laboratory received flash burns from an electrical arc blast when a metal cover contacted an energized bus bar as they attempted to connect a neutral cable for a temporary feed from a 480-volt motor control center panel. One subcontractor was treated for burns to his hands and immediately released; the other was transported by helicopter directly to a hospital with a burn unit where he was treated for burns to his face and hands. (*Type B Accident Investigation Board Report on the October 22, 1997, Electrical Arc Blast at Building F-Zero Fermi National Accelerator Laboratory Batavia, Illinois*, November 1997; and ORPS Report CH-BA-FNAL-FERMILAB-1997-0004)

These events illustrate the importance of conducting thorough pre-job planning, including an activities hazard analysis of all anticipated work activities. Conducting a hazard analysis would have shown that the control center needed to be electrically isolated with a lockout/tagout. Facility managers are ultimately responsible for ensuring successful completion of work activities. Routine monitoring of contractor and subcontractor work by facility managers and supervisors will help ensure that electrical maintenance activities are conducted in accordance with facility policy and procedures. This event also illustrates the importance of ensuring that subcontractor personnel understand and follow facility notification processes. In this event, had the facility representative not been present, the subcontractor electrician would have continued work, and no one would have been aware of the damage until the transformer was returned to service.

Facility managers, work planners, and crafts personnel should review the following references, which provide guidance and good practices for planning electrical work.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, states that DOE policy is to operate DOE facilities in a manner to ensure an acceptable level of safety and that procedures are in place to control conduct of operations.

- DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities,* provides guidance to maintenance organizations to ensure that work package planning, scheduling, and coordination identify all technical and administrative requirements for a work activity to be safely and effectively completed.

- 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* provide guidance on the implementation of effective lockout/tagout programs. These references both state that the primary purpose of a lockout/tagout program is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. 29 CFR 1910, sub-part S, "Electrical," describes work practices to be employed to prevent injuries when work is performed near or on equipment or circuits that are, or may be, energized.

- DOE/ID-10600, *Electrical Safety Guidelines*, prescribes electrical safety standards for DOE field offices and facilities. Included in the guidelines is information on training and qualifications, work practices, protective equipment, insulated tools, and recognition of electrical hazards. Section 2.13.1.3 states that when circuits and equipment are worked on they must be disconnected from all electrical energy sources. These guidelines are intended to protect personnel from electrical shock and potential fatalities.

- DOE-HDBK-1092-98, *Electrical Safety*, contains explanatory material in support of OSHA regulations and nationally recognized electrical safety-related standards. This document addresses electrical safety for enclosed electrical and electronic equipment and discusses the latest editions of 29 CFR 1910 and 1926 and National Fire Protection Association Standard 70E, “National Electrical Code.”

- The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that control job-associated hazards, such as physical barriers, procedural or administrative barriers, or human action. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in series to provide defense-in-depth and to increase the margin of safety. The guide includes a hazard-barrier matrix that shows that lockout/tagout is the most effective barrier against injury. When implemented properly, lockout/tagout provides a high probability (greater than 99 percent) of success for risk reduction. The guide provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

A copy of *The Hazard and Barrier Analysis Guide* may be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874.

KEYWORDS: breaker, electrical safety, hazard analysis, near-miss, work planning

FUNCTIONAL AREAS: Electrical Maintenance, Hazards and Barrier Analysis, Work Planning, Industrial Safety

3. MISSING SOIL SAMPLES AT HANFORD

On July 30, 1998, at the Hanford Site Waste Sampling and Characterization Facility, a sample custodian discovered that five soil samples were missing from their storage location. The

missing samples are not regulated under the Resource Conservation and Recovery Act. However, two of them contained greater than 50 parts per million of polychlorinated biphenyls, which is the threshold for use restrictions under the Toxic Substances Control Act. Lost laboratory samples can result in personnel exposures and can result in regulated materials being handled and disposed of improperly. (ORPS Report RL--PHMC-WSCF-1998-0002)

Facility personnel searched for the missing soil samples at the Waste Sampling and Characterization Facility and at all facilities that received returned soil samples, but they were unable to find them. They also searched sample logbooks and chain of custody forms and found no evidence that the missing soil samples were shipped from the Waste Sampling and Characterization Facility. The facility manager will assess the personnel qualifications of the sample coordinator, sample custodian, and waste coordinator. He will also assess sample archive/retention procedures. The facility manager identified weaknesses in the chain of custody, sample disposition and retention procedures, and personnel training and qualification. He directed that personnel in key positions receive additional training and placed an administrative hold on routine release of samples.

OEAF engineers reviewed the complete ORPS database for similar reports involving violations of chain of custody procedures for laboratory samples and identified three events.

- On July 18, 1996, at the Sandia National Laboratories, facility personnel declared that environmental samples were missing. Investigators determined that chain of custody procedures were not followed when the sample was removed from the sample management facility by unknown persons. (ORPS Report ALO-KO-SNL-7000-1996-0006)

- On November 4, 1994, at the Rocky Flats Environmental Technology Site, the industrial hygiene coordinator signed another employee's name to the "relinquished" section on a chain of custody form for asbestos samples. The coordinator then took custody of the samples and sent them off-site for analysis before technicians could survey the samples for radioactivity. (ORPS Report RFO--EGGR-SUPPORT-1994-0034)

- On February 13, 1992, at the Hanford Site, a sample custodian could not locate a rain water sample sent to the laboratory for radiological analysis. Investigators determined that both the custodian and an analysis group employee failed to complete documentation transferring custody. (ORPS Report RL--WHC-ANALLAB-1992-0004)

In each of these occurrences, the facility manager attributed the direct cause to personnel error (procedure not used or used incorrectly). Also, in each of these occurrences, the facility manager assigned corrective actions that included improving access control to samples.

These events underscore the importance of having and using well-written chain of custody procedures and adequately training personnel on these procedures. DOE-STD-1029-92, *DOE Writers Guide for Technical Procedures,* establishes the recommended process for developing technical procedures that are accurate, complete, clear, and consistent. The guide provides guidance for developing a procedure basis; planning, organizing, and structuring the procedure; developing content and establishing format; and writing action steps. DOE and facility managers should review their procedures to ensure they meet the requirements of this standard. Procedures for laboratory sample chain of custody establish the process of documenting, controlling, securing, and accounting for physical possession of samples, from initial collection through final disposition. Elements of a chain of custody form include, but are not limited to, the following.

- sample identification number
- date and time of sample collection
- sample type
- container type
- preservatives used
- type of analysis to be performed
- sample results
- signatures of custodians
- dates of receipt and relinquishment

Additional information on polychlorinated biphenyls and the Toxic Substances Control Act is available from the Toxic Substances Control Act Information Service at (202) 554-1404. The Service operates under contract to the Environmental Protection Agency and is staffed by professionals trained to answer questions about the Act. The Service also stocks Toxic Substance Control Act-related documents, which are available free of charge.

KEYWORDS: access control, procedures, sampling, training and qualifications

FUNCTIONAL AREAS: Procedures, Training and Qualification

4. DRUM PRESSURIZATION LEADS TO CHEMICAL EXPOSURE AT SAVANNAH RIVER

On August 25, 1998, at the Savannah River Hazardous Waste Storage Facility, a waste operator was exposed to chemical vapors and residue when internal pressure blew the lid from an 85-gallon overpack drum containing 1,1,1 trichloroethane and its decomposition products. He immediately exited the facility to flush his eyes at an eyewash station. The operator also complained of nausea and a burning sensation in his lungs, so medical personnel transported him to a local hospital for examination and treatment. X-rays and blood tests revealed no indication of chemical contamination. Trichloroethane can break down thermally into hazardous compounds, such as hydrogen chloride (hydrochloric acid), phosgene, chlorine, carbon dioxide, carbon monoxide, and various hydrocarbons. Pressurized drum accidents can result in severe physical, chemical, or radiological injuries. (ORPS Report SR--WSRC-SLDHZD-1998-0008)

Investigators determined that the operator was venting the container in preparation for lid removal and sampling by loosening the locking ring and slightly opening the lid to release headspace gases. They also determined the following.

- A pre-job hazard analysis did not address the possibility of drum pressurization.

- Job planners did not identify appropriate personnel protective equipment. The job-specific personnel protective equipment plan only required workers to wear work gloves and sturdy shoes and did not require respiratory protection.

- The accessibility and distance of the emergency eyewash/shower from the job did not meet OSHA requirements or those in the Westinghouse Savannah River Company Employee safety manual.

- Lessons learned and corrective actions from a similar incident involving a pressurized drum in the same facility were not effectively implemented.

The facility manager immediately terminated all waste sampling activities and initiated a root cause investigation. The facility manager also directed facility personnel to develop an

improved procedure for venting the remaining drums. DOE Savannah River Operations personnel are providing oversight of the investigation.

NFS has reported drum pressurization events in several Weekly Summaries. Following are some examples.

- Weekly Summary 98-21 reported that a waste operations employee at the Idaho National Engineering and Environmental Laboratory was opening a 55-gallon drum when the lid lifted forcefully because of internal pressurization. The lid brushed the face of the employee and hit the wall and ceiling of the cargo container in which the drums were stored. The drum contained dry, granular, depleted uranium oxides. (ORPS Report ID--LITC-SMC-1998-0004)

- Weekly Summary 97-03 reported that a hazardous waste worker was loosening a bolt on a 110-gallon drum ring at the Fernald Environmental Management Project when the lid blew off, striking the ceiling 14 feet above the worker and coming to rest on the floor 3 feet away. (ORPS Report OH-FN-FDF-FEMP-197-0003)

- Weekly Summary 96-42 reported on two events involving lids that were blown off pressurized drums when the locking rings were loosened. At the Paducah Plant, a waste sampler loosened a locking ring with a hammer. The ring, the lid, and some contents blew out of the drum. At the Hanford Tank Farms, an operator loosened and moved the locking ring on a drum, and the lid flew 2 to 3 feet into the air and fell back on the drum. (ORPS Reports ORO--LMES-PGDPENVRES-1996-0002 and RL--PHMC-TANKFARM-1996-0076)

These events underscore the dangers associated with stored waste material that can result in chemical reactions and pressurization of storage containers. These reactions can occur from the mixing of incompatible chemicals, the storage of materials in incompatible containers, or the decay and decomposition of organic materials. Facility managers also need to ensure that procedures and methods for opening sealed drums and containers include precautions and guidance for preventing lids from being blown off.

Following the May 14, 1997, chemical explosion at the Hanford Plutonium Reclamation Plant (ORPS Report RL--PHMC-PFP-1997-0023 and Weekly Summary 97-21), the Office of Environment, Safety and Health issued DOE/EH-0554, Safety Alert 97-1, “Chemical Explosion at Hanford.” This notice discusses long-term changes to chemicals stored in vessels or drums because of degradation or concentration. In June 1997, NFS issued DOE/EH-0557, Safety Notice 97-01, "Mixing and Storing Incompatible Chemicals, "as a result of the Hanford event and a May 22, 1997, overpressurization and rupture of a waste shipping container at Fernald (ORPS Report OH-FN-FDF-FEMP-1997-0034). The notice contains lessons learned related to the mixing and storing of incompatible chemicals.

The following additional DOE and industry documents provide valuable guidance for all personnel who work with chemicals and hazardous materials.

- 29 CFR 1910.119, “Process Safety Management of Highly Hazardous Chemicals,” contains the requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals.

- ES&H Bulletin DOE/EH-0296, “Mixing of Incompatible Chemicals,” February 1993, provides information about the hazards associated with mixing of incompatible chemicals.

- DOE/NS-0013, Safety Notice 93-1, “Fire, Explosion, and High-Pressure Hazards Associated with Waste Drums and Containers,” discusses handling, storing, venting, and opening containers suspected of being pressurized or containing flammable vapors.

- DOE-HDBK-1100-96, *Chemical Process Hazards Analysis,* February 1996, and DOE-HDBK-1101-96, *Process Safety Management for Highly Hazardous Chemicals,* February 1996, provide guidance for DOE contractors managing facilities and processes covered by the OSHA Rule for Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119).

- DOE Defense Programs Safety Information Letter, SIL 96-01, *Incidents from Chemical Reactions due to Lack of or Failure to Follow Proper Handling Procedures,* June 1996, provides guidance to prevent these incidents.

- DOE Defense Programs Safety Information Letter, SIL 96-05, *Compatibility Considerations in the Mixing of Waste Chemicals,* November 1996, addresses these issues and provides a guide to available information.

Copies of Safety Alert 97-1 and Safety Notices can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the Operating Experience Analysis and Feedback Home Page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. OSHA Regulations are available on the OSHA Home Page at URL http://www.osha-slc.gov/OshStd_data. Copies of ES&H Bulletins can be obtained on the ES&H Documents Collection Home Page at http://www.tis.eh.doe.gov/docs/docs.html or by writing the Safety Performance Indicator Division, Office of Environment, Safety and Health, U.S. Department of Energy, Washington, DC 20585. DOE Handbooks are available on the Department of Energy Technical Standards Home Page at URL http://www.doe.gov/html/techstds/standard/standard.html. Safety Information letters can be obtained by contacting Tom Rotella, Defense Programs, Office of Engineering, Operations, Security, and Transition Support, at (301) 903-2649 or thomas.rotella@dp.doe.gov.

KEYWORDS: pressurized drum, waste, chemical reaction, chemical spill

FUNCTIONAL AREAS: Materials Handling and Storage, Chemistry, Industrial Safety